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Update on TAO moored ORG Array

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Present Array Status

During COARE six TAO moorings were equipped with ORGs. In late 1993 moorings deployed on the equator at 154E and 157.5E were recovered and not redeployed as they were augmentations to the TAO array for COARE only. In December 1993, four TAO moorings were equipped with ORGs; One each at 2N, 156E and 2S, 156E and ORG doublets on the equator at 0, 156E and 0, 165E. The 2N, 156E mooring has been lost. By the end of April all sites will have been serviced and six refurbished sensors will again be deployed in the same locations.

COARE comparisons: Moored ORG's with NATSUSHIMA and IMET Buoy

R/V NATSUSHIMA remained within a mile of the 0, 156E mooring for about 6 days in February, 1993. Two major and several minor rain events occurred during the 6-day period. Both moored and shipboard ORG's agreed on the timing of both major and most minor events. The means of all non-zero hourly rainrates differed by 1.6 mm/hr (7.7 *vs* 6.1 mm/hr). The largest hourly means differed by 14 mm/hr (38 *vs* 24 mm/hr).

The WHOI IMET mooring returned rain data from a RM Young capacitive rain gauge for 14 days in October/November 1992 and for 9 days in December 1992. The IMET buoy was deployed about 15 miles from the PMEL mooring at 2S, 156E. The IMET and TAO data do not compare as well as the TAO ORG *vs* NATSUSHIMA ORG data, which may be attributed to the possibility that 15-miles between moorings exceeds the correlation scale for these rain events. Two points may be made about the general character of the IMET vs TAO data: 1) More events occur in TAO time series and 2) The percentage of an hour that the IMET measured rain was a much more noisy time series and had a tendency after major rain events to indicate light rain, while the TAO ORG indicated none. Some of the differences are probably due to different processing methods, but the RM Young sensor may also be more likely to be noisy in a moored buoy environment.

Feb-Dec 93 Array

Due to problems with ship scheduling in the western Pacific, the TAO array of moorings equipped with ORGs deployed in February/March 1993 were not serviced again for up to 10 months, which was significantly longer than the designed deployment length of 6 months. Most of the batteries deployed in February/March 1993 dropped below 11v (the minimum operating voltage specified by STI) within 3 to 5 months. STI has since

informed us that a modification to the sensors had produced a higher current drain than specified in their manual. Seemingly reasonable data were returned long after the sensor battery dropped below 11v, although we have no confirmation that the data are accurate.

Five of the six moorings in the ORG array had signs of vandalism on recovery in December. The majority of damage was done to wind, temperature and humidity sensors, but in one case the infrared transmitter and support rods were missing from an ORG. A second ORG had its rods broken during recovery. The combination of longer than normal deployments, high current drain and vandalism resulted in a data return of only 65%.

Comparison of moored doublets

Time series of hourly data from ORG pairs mounted on the same buoy show coincident events, but values can be significantly different, with one sensor consistently measuring more rainfall than the other. At 0, 156E (Fig. x) the percent (of the hour raining) differed on average by about 6%, indicating a threshold difference. The hourly mean rainfall rates differed by 29%. One of the sensors at 0, 165E had been turned around at sea. Within a few days of deployment it had several events which were much larger than its partner. After that, differences between the two sensors were more like those at 0, 156E. After omitting the first few days the percent data differed by about 6% on average (Fig. y). The hourly mean rainfall rates differed by 55%. All four sensors have been recovered and replaced and will be returned to Wallops for checkout and calibration.

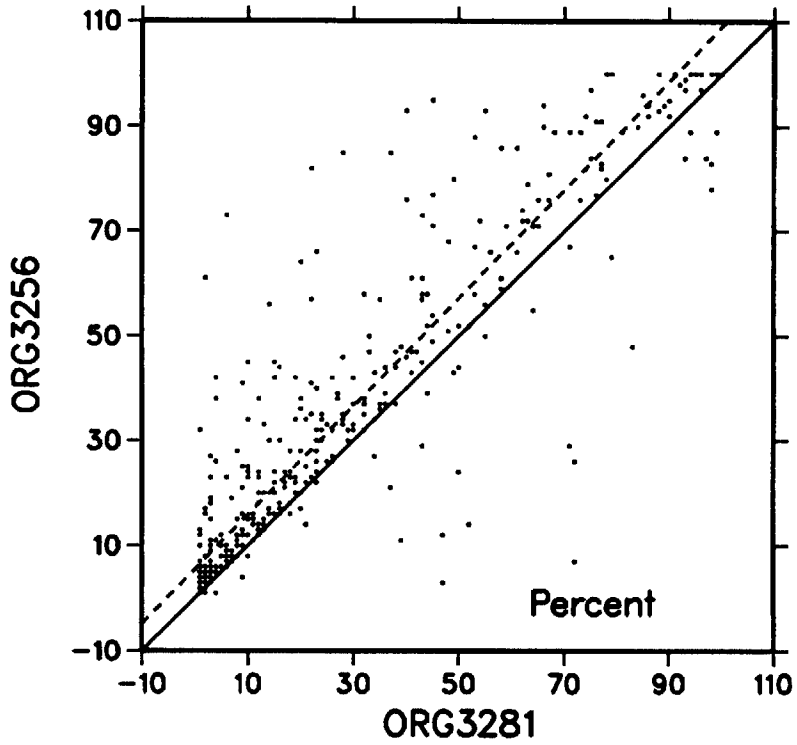
Pre-deployment sensor checkouts

Before the most recent field work two ORGs recently placed at 165E were tested in natural rain conditions for 3 weeks at PMEL before deployment. While several rain events occurred during this period, none had hourly means larger than 3 mm/hr. It appears that rainrates in Seattle are not sufficient for sensor checkout.

Shortly before shipping sensors and electronics for the most recent deployments we were able to test two sensors for 8 days at Quinalt Ranger Station in Olympic National Park. This site was selected because it has an annual rainfall of about 3500 mm (mostly in winter) and is near a regularly manned ranger station. Unfortunately, very little rain fell during the 8-day period. The largest hourly mean was 4 mm/hr and the largest sample was 42 mm/hr (compared to 19 mm/hr in Seattle).

We plan to install a more permanent test facility this fall at Quinalt. We envision several (~6) ORGs, 1 or 2 RM Young capacitive gauges and a weighing gauge being continuously monitored by a PC. We hope to have phone communications to the PC over which data can be transferred to PMEL on a daily basis. We welcome advice on hardware selection and sampling and processing schemes and hope to draw upon the experience of both the Wallops and AOML test facilities.

Mooring TC2: 0°, 156°E

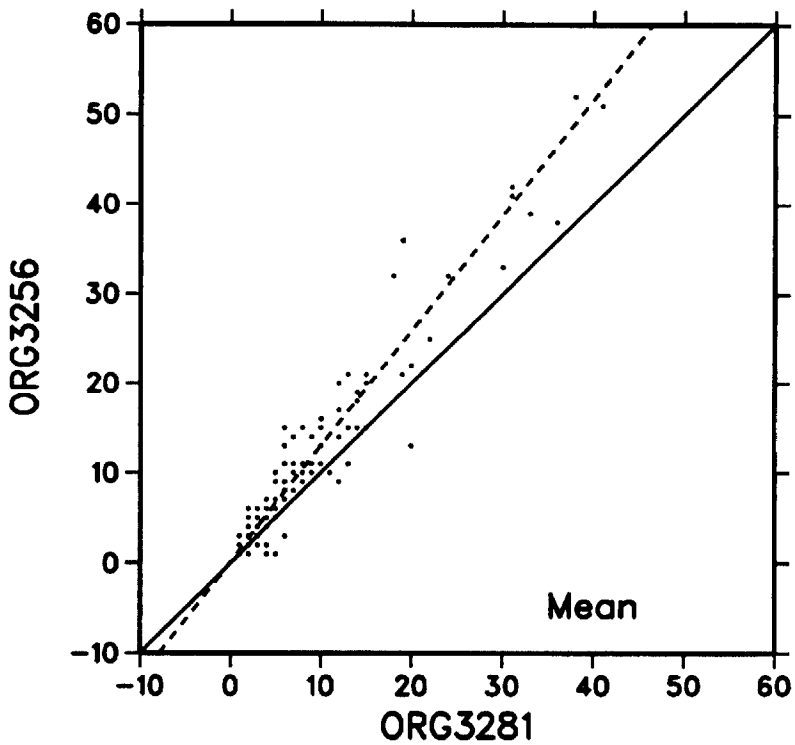


FROM 0000 19 DEC 93 TO 0000 13 APR 94

	MIN	MAX	MEAN	STD DEV
x:	1.000	100.000	33.118	31.447
y:	1.000	100.000	39.766	32.439

n: 389 r: 0.91

y = a + bx: a = 5.50 , b = 1.03



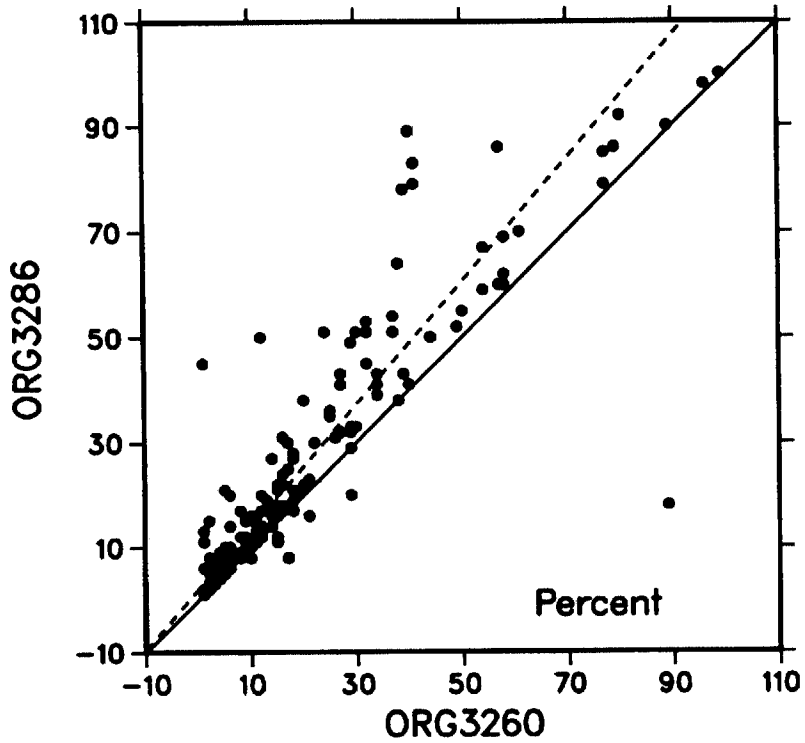
FROM 0000 19 DEC 93 TO 0000 13 APR 94

	MIN	MAX	MEAN	STD DEV
x:	1.000	41.000	5.294	6.980
y:	1.000	52.000	6.953	8.923

n: 235 r: 0.97

y = a + bx: a = 0.135 , b = 1.29

Mooring TC1: 0°, 165°E

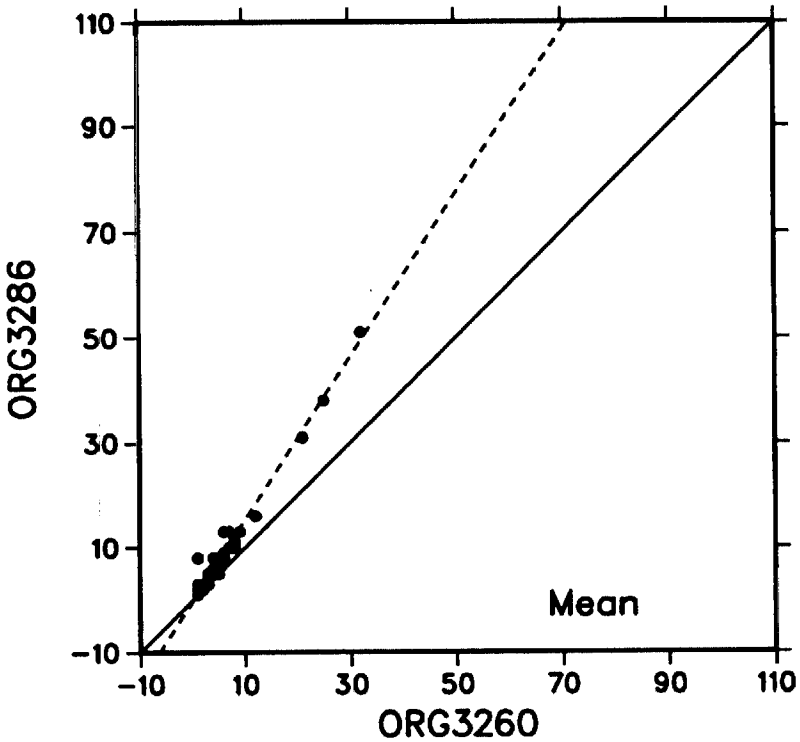


FROM 0000 1 JAN 94 TO 0000 13 APR 94

	MIN	MAX	MEAN	STD DEV
x:	1.000	99.000	20.802	21.052
y:	1.000	100.000	26.475	24.176

n: 162 r: 0.89

y = a + bx: a = 2.17 , b = 1.17



FROM 0000 1 JAN 94 TO 0000 13 APR 94

	MIN	MAX	MEAN	STD DEV
x:	1.000	32.000	3.356	4.827
y:	1.000	51.000	5.000	7.442

n: 90 r: 0.99

y = a + bx: a = −0.200 , b = 1.55